## A RED TIDE OF *TRICHODESMIUM* IN COASTAL WATERS OF WESTERN AUSTRALIA

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During the Easter vacation of 1972 several people reported the occurrence of a waterbloom or red tide of the planktonic alga, *Trichodesmium erythraeum* Ehrenberg in the sea on the south west coast of Western Australia.

Samples of the alga were brought to my laboratory from Careening Bay at Garden Island, from six miles north of Rottnest Island, and from Geographe Bay, 148 miles south of Fremantle. Another sighting of this alga was reported by an angler some 15 miles out to sea from Lancelin island, 84 miles north of Fremantle. The angler drove his power boat for some 10 miles through the red-brown bloom and noted several small fish floating dead in it. Another angler reported the bloom from 25 miles west of Fremantle and described it as "in vast swathes, looking like gravel roads in the sea." At Careening Bay, Rottnest Island and Geographe Bay the bloom was extensive, dense and in some areas a pale green while in others a red-brown. At Careening Bay the prevailing wind blew the bloom ashore where it dried as a rusty film on the beach when the tide receded. It soon gave off an offensive odour under the high temperatures which prevailed over Easter.

Three other collections of this species are in the Herbarium of the Botany Department. In August, 1964, *Trichodesmium* was collected from Salmon Bay, Rottnest Island, where it lay thickly over drift seaweed. In March, 1964, it was collected from a thick drift on the beach at Cottesloe. In August, 1966, an officer for Merz and McLellan and Partners, Consultant Engineers, collected it from the sea at Dampier, north-western Australia, where it was feared the malodorous alga would affect the potability of water being distilled from seawater to supplement the Dampier town water supply. The first record of this alga on our coast, so far as I am aware, was some time during the Second World War when the Department of the Navy brought a specimen to the Botany Department for identification. The Navy was checking flotsam which might indicate a maritime disaster and particularly any manifestation of enemy action along our coast.

*Trichodesmium* is a genus of filamentous blue-green algae (Cyanophyta) with a single freshwater species and five marine planktonic species inhabiting the warmer seas. *T. erythraeum* has been recorded from the Philippines, East Indian Archipelago, along the east coast of South America, the Red Sea, Arabian Sea and in the northern Indian Ocean (Ballantine and Abbott, 1957; Desikachary, 1959; De Toni, 1846). The genus is distinguished by the planktonic and colonial habit of its filaments which are fascicled to form spindle-shaped rafts (Fig. 1). It propagates by filaments breaking loose from the colonies and growing to form new fascicles.

The colour variation commonly shown by many species of Cyanophyta is the result of environmental conditions causing changes in the proportions of their component pigments, which include chlorophyll a, B-carotene, several xanthophylls and two phycobilins (c-phycocyanin—a blue-green pigment, and c-phycoerythrin—a red pigment). As already mentioned, *Trichodesmium erythraeum* has colour forms of pale blue-green, brown or rouge-red. When red-brown forms are killed in formalin-seawater, the water-soluble phycobilins escape from the cells to colour the preservative a bright pink or dark red.

The term 'waterbloom' refers to population explosions of algae or protozoa brought about by optimum environmental conditions. In the sea, waterblooms of several species of planktonic algae are commonly known as 'red tides' or 'red water', although the colour of the blooms may vary from red to brown, green, yellow or merely cloudy.

The causes of red tides are not yet fully understood. It is known that high concentrations of nutrients, particularly nitrate and phosphate, must be available, temperatures must be suitable and there must be sufficient populations of the phytoplankton to take advantage of these conditions while they last. These requirements can arise in a number of ways. In the open seas the upwelling of deep nutrient-rich water will often favour the waterbloom condition, while nearer the coast the seasonal outflow of river water rich in nutrients can initiate blooms.

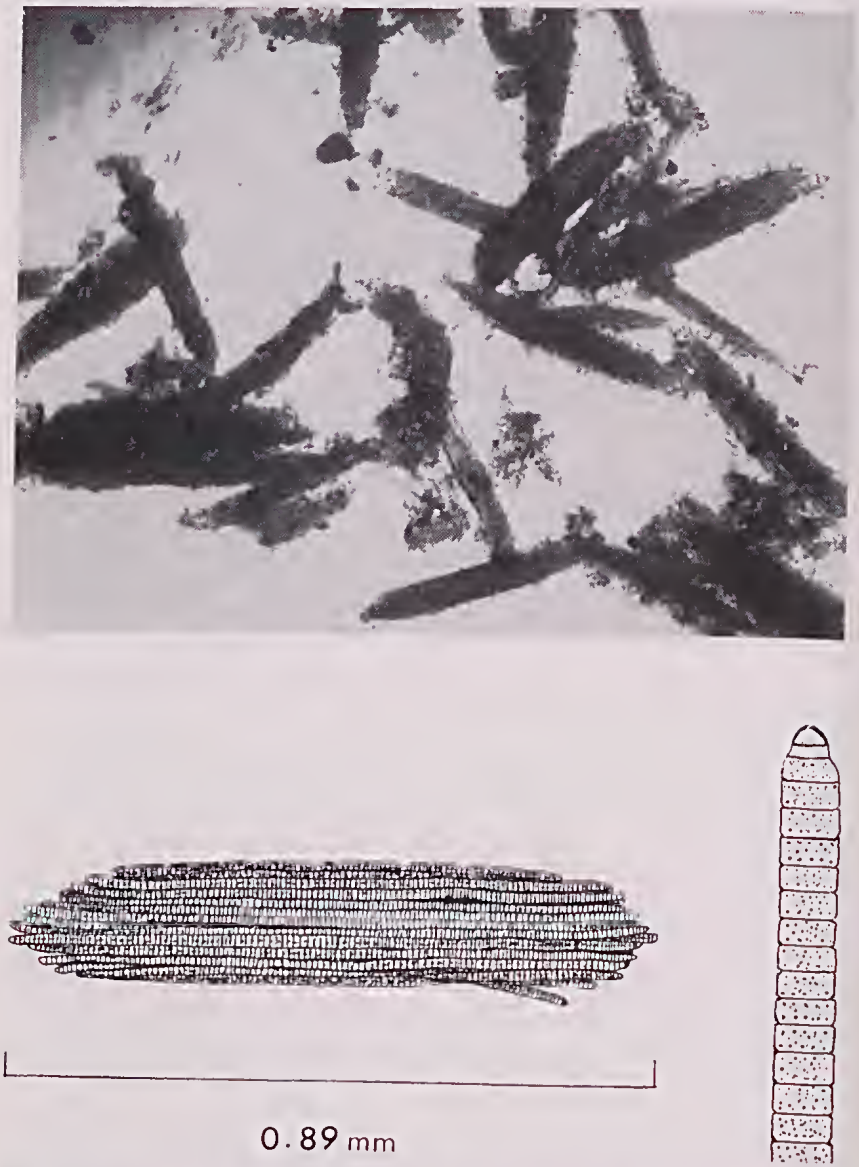


Fig. 1—*Trichodesmium erythraeum* Ehrenb. Upper; Microphotograph of bloom, x 34; lower: a colony and a single filament.

Some blooms may be quite harmless, while others lead to mass mortality of fish and other marine animals by releasing toxins or by their secondary effects such as causing oxygen deficiency in the water, liberation of hydrogen sulphide as a result of cell decomposition or by favouring bacterial pollutions of the dying and decaying waterbloom (Ballantine and Abbott, 1957). Blooms of *Trichodesmium* species are of variable toxicity and only occasionally cause mortality of fish, due mostly it seems to choking up of their gills rather than to toxins produced by the alga (Desikachary, 1959). Rarely is *T. erythraeum* a pollutant of our beaches.

Several other planktonic algae of the high seas are responsible for red tides and mass mortality of marine fauna. The principal species and the areas in which they have caused massive blooms are briefly reviewed by Ballantine and Abbott (1957). The most toxic species is the notorious dinoflagellate, *Gymnodinium brevis* which blooms seasonally in the Gulf of Mexico where it has been known to kill fish and other fauna on a vast scale (Tiffany, 1958:163). This alga releases a toxin which fatally paralyses the nervous system of fish, although oxygen depletion of the water by the alga is also considered to contribute to the mortalities.

*Trichodesmium erythraeum* is of historical interest too. The periodic reddening of the water which has given the Red Sea its name is generally attributed to this alga. There is some well documented evidence for this claim (Hassal, 1845) but other planktonic algae such as *Peridinium* may also contribute to the coloration.

Moldenke and Moldenke (1952) in their erudite work, *Plants of the Bible*, think the several references in the Bible to waters of the sea and the rivers becoming blood might well be connected in some way with red tides of *Trichodesmium* observed in ancient times.

> *EXODUS, 7:17-19 . . . I will smite with the rod that is in mine hand upon the waters which are in the river, and they shall be turned to blood. And the fish that is in the river shall die, and the river shall stink; and the Egyptians shall loathe to drink of the water of the river . . . and upon all their pools of water, that they become blood.*
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> *REVELATION, 8:8 . . . and the third part of the sea became blood.*

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